

Rim Fire Simulated in CESM/CARMA

A firefighter in full protective gear, including a yellow helmet and a large black backpack, stands with their back to the camera, looking at a large, intense fire. The fire is consuming dry brush and trees in a field, with thick orange and yellow flames and a large plume of white smoke rising into the sky. The scene is set in a dry, hilly landscape with some bare trees in the background.

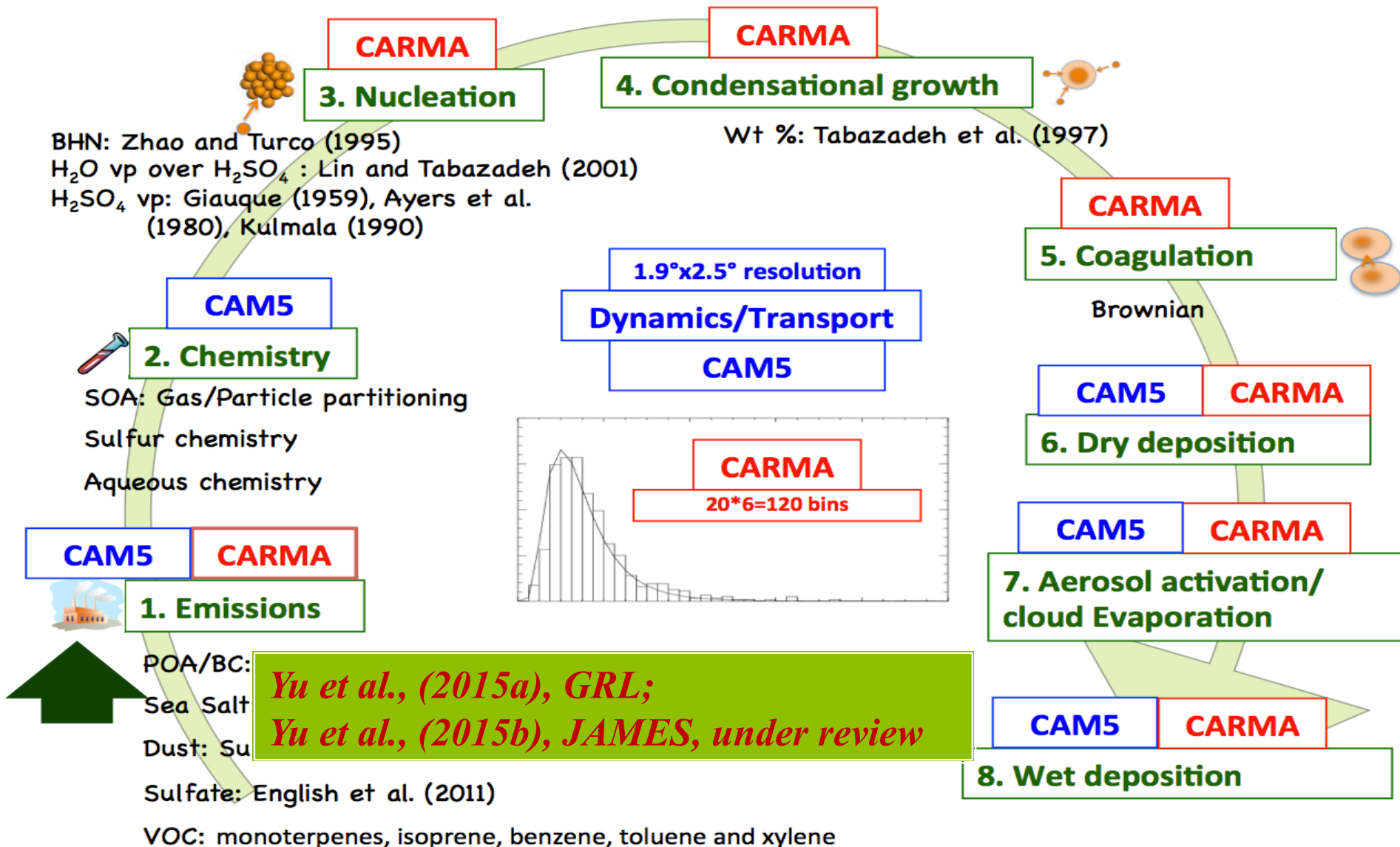
Pengfei Yu, Owen Brian Toon,
Charles Bardeen, Cynthia Randles, Peter Colarco, Pablo Saide,
LARGE Team, AMS Team, HDSP2 Team

ATOC, LASP, University of Colorado at Boulder

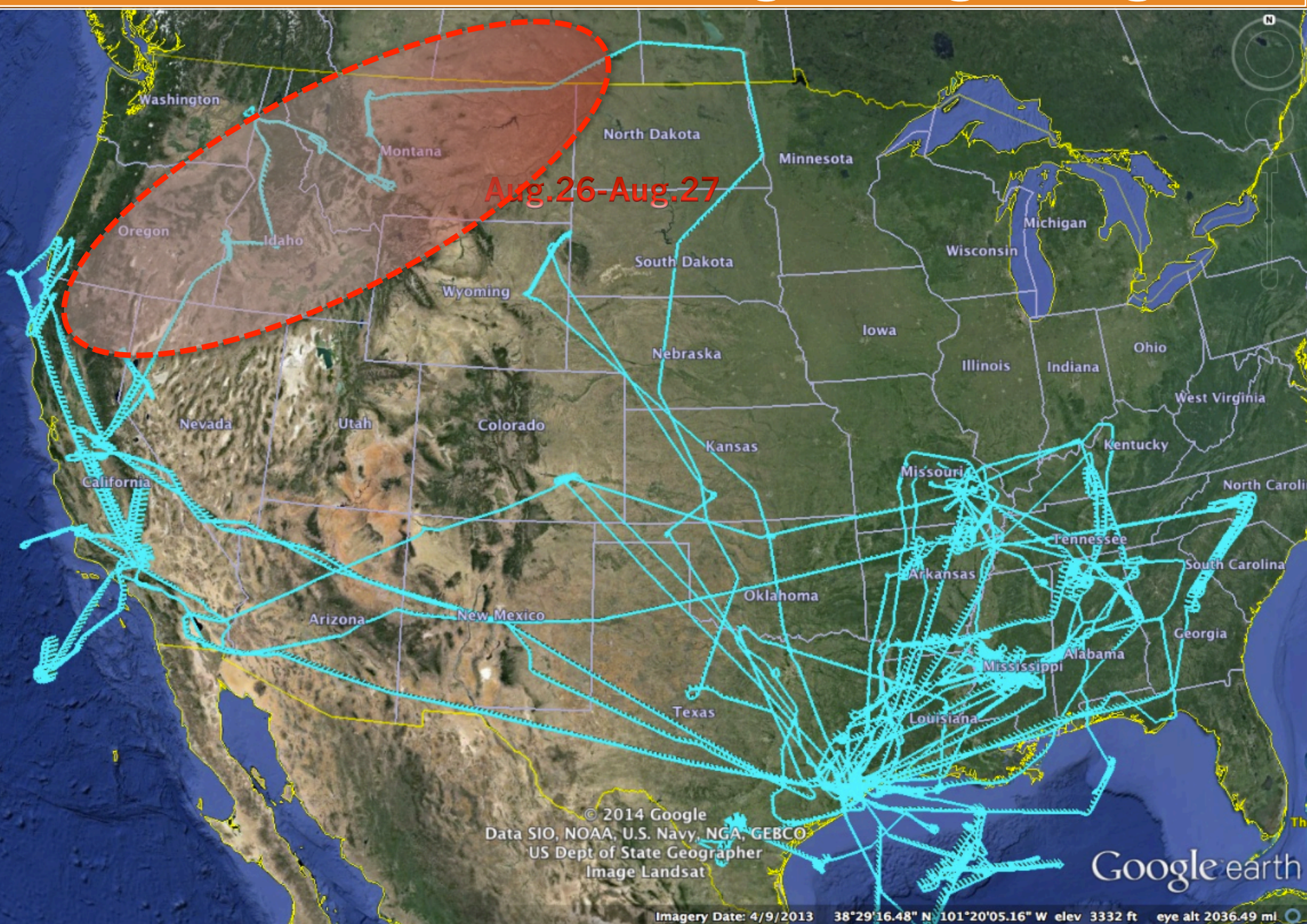
April 2015, SEAC4RS Science Meeting

CARMA is a Sectional Aerosol Microphysics/ radiation model coupled with CAM5

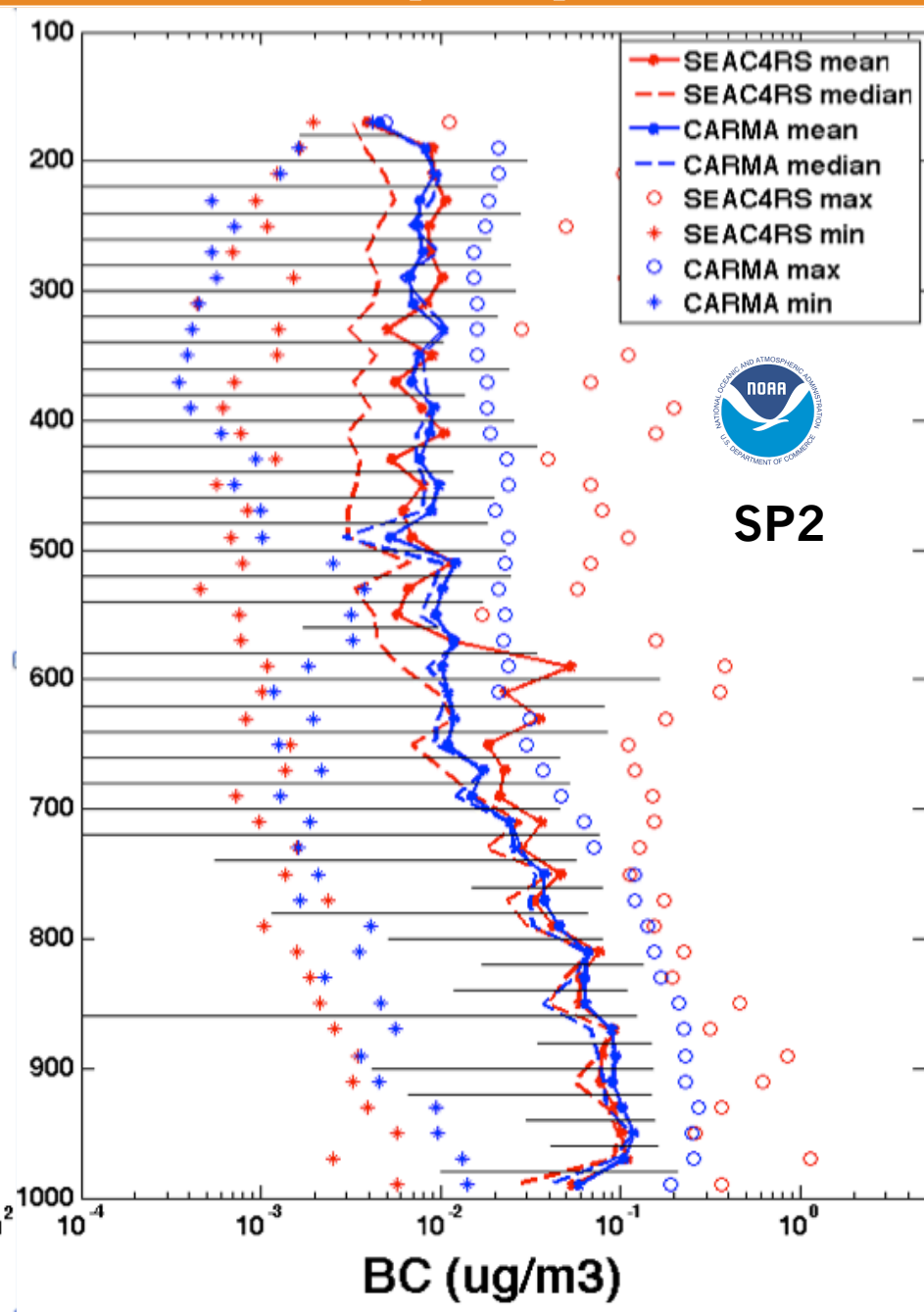
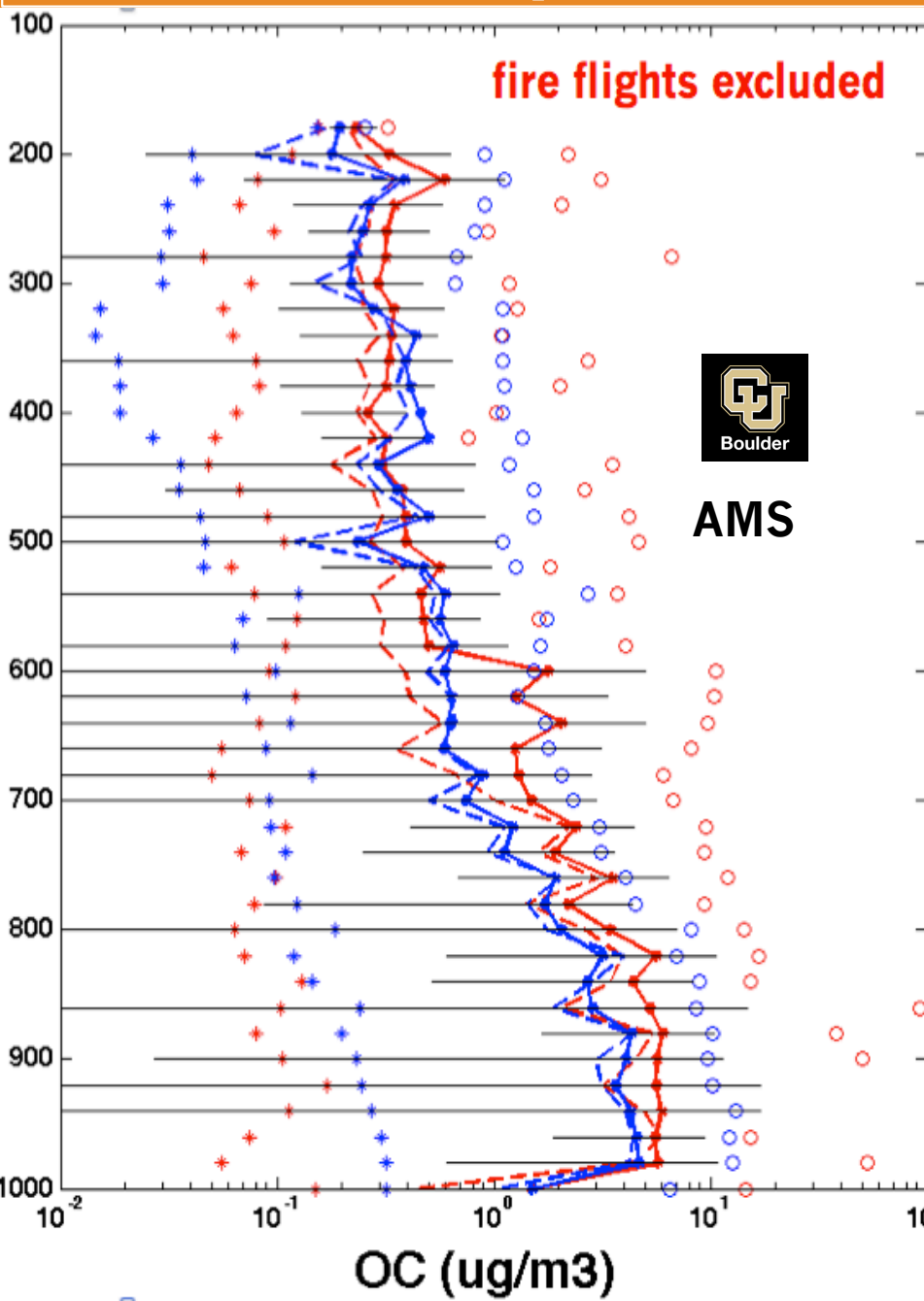
CAM5/CARMA Model



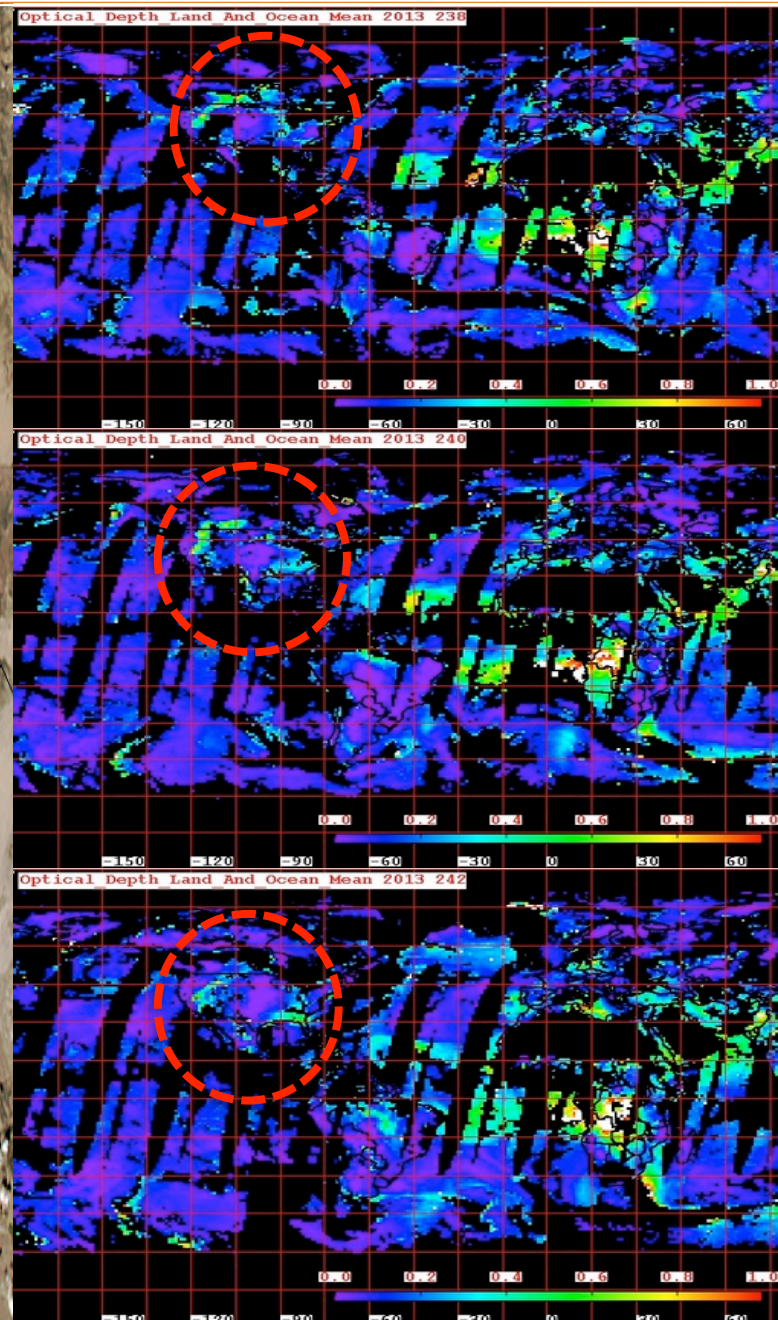
SEAC⁴RS – We focus on Aug.26-Aug.27 flight



Model captures OC/BC in troposphere



MODIS shows Rim Fire plumes, Aug.2013



Aug.26

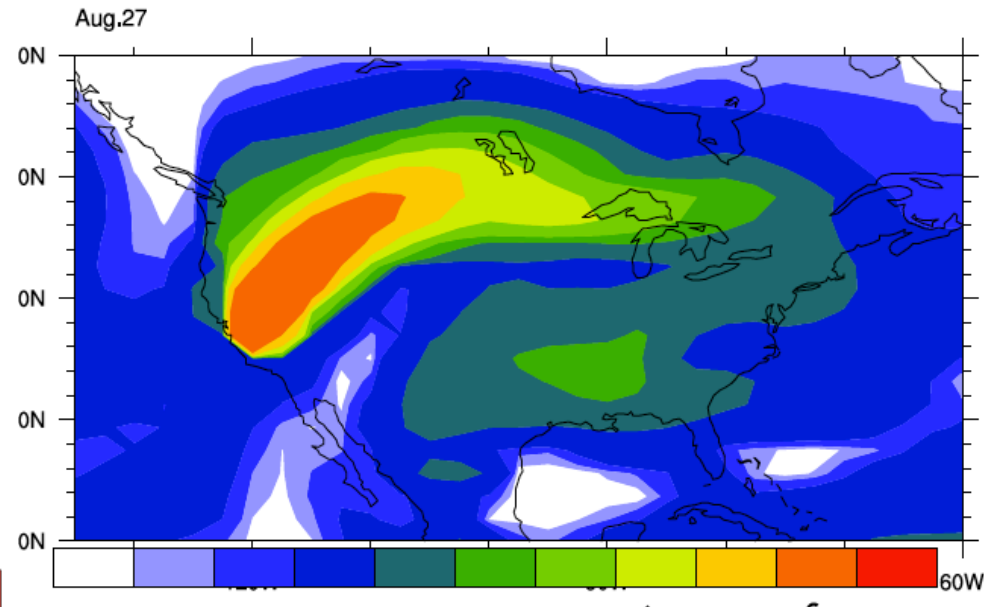
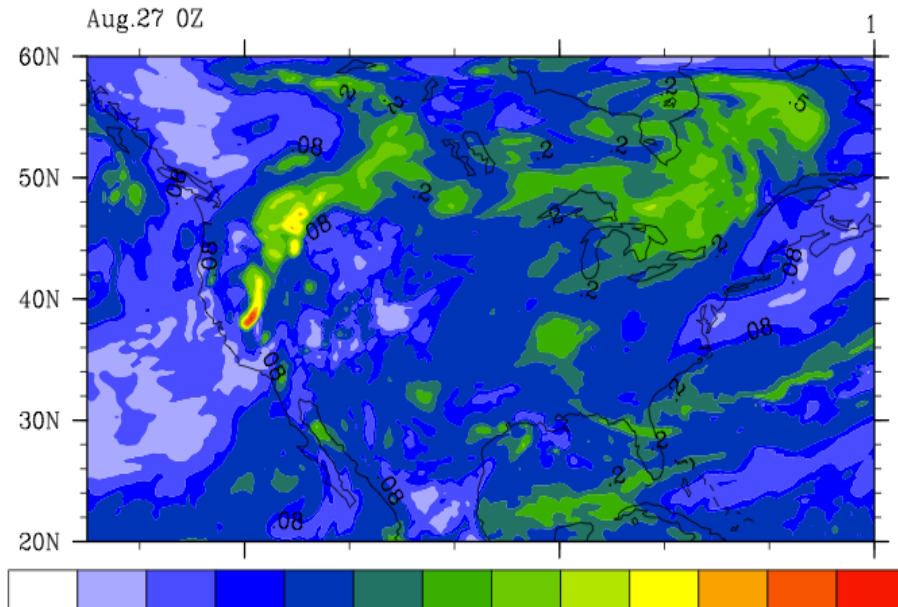
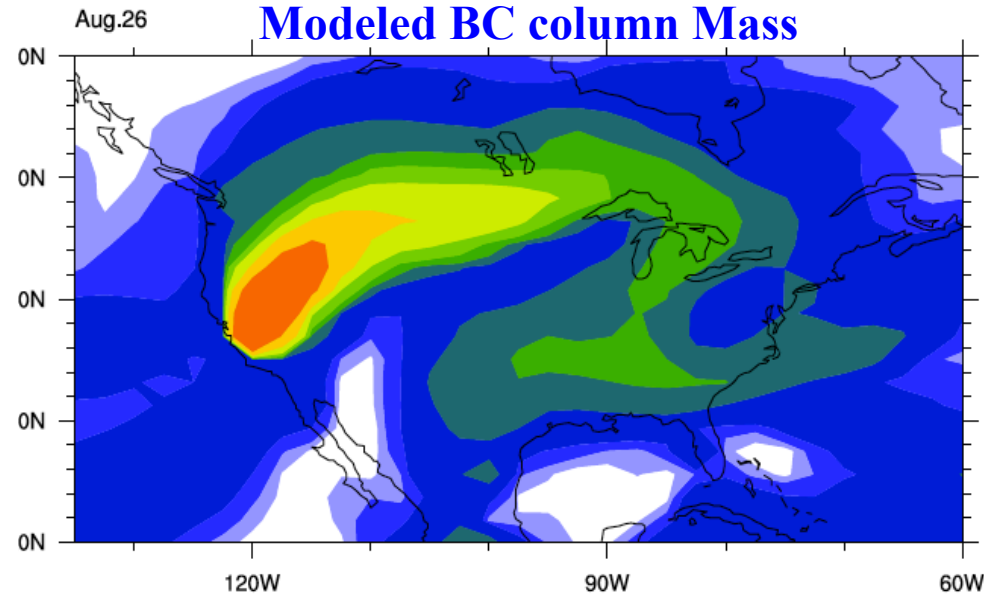
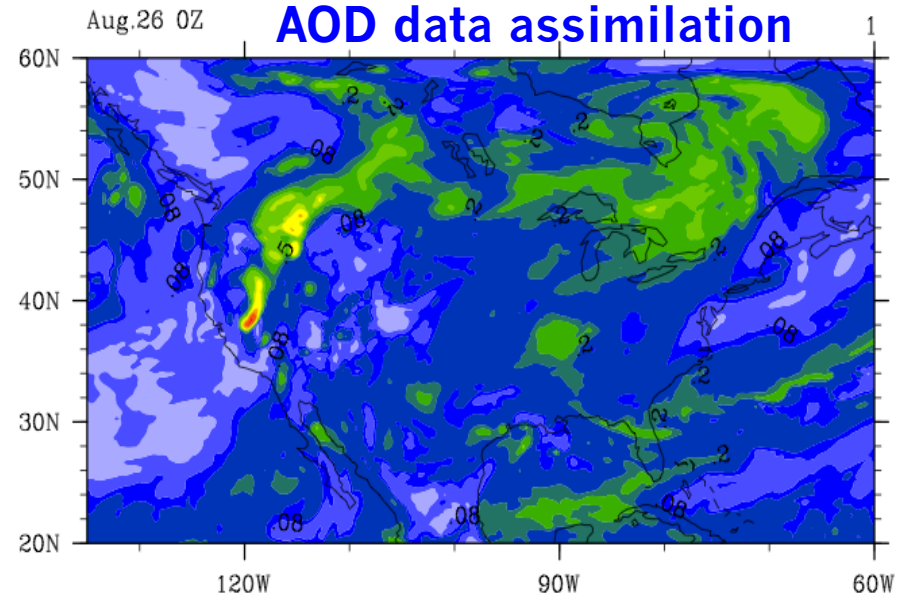
Aug.28

Aug.30

Conclusions in this Talk

- **Injecting** Rim Fire emission at 550-650 mb in GCM provides better performance;
- CARMA predicts Rim Fire Aerosol **Mass, Number, Volume, Surface Area** within data variability;
- Rim Fire Aerosol is roughly 0.1-0.2 μm in **Radius**;
- CARMA reproduces Rim Fire **Extinction** within data variability;
- Modeled **Single Scattering Albedo** is lower than observations; Modeled **Single Scattering Albedo** is higher in smoke;
- CARMA shows Rim Fire Smoke is **cooling** the surface by up to 30 W/m^2 ;

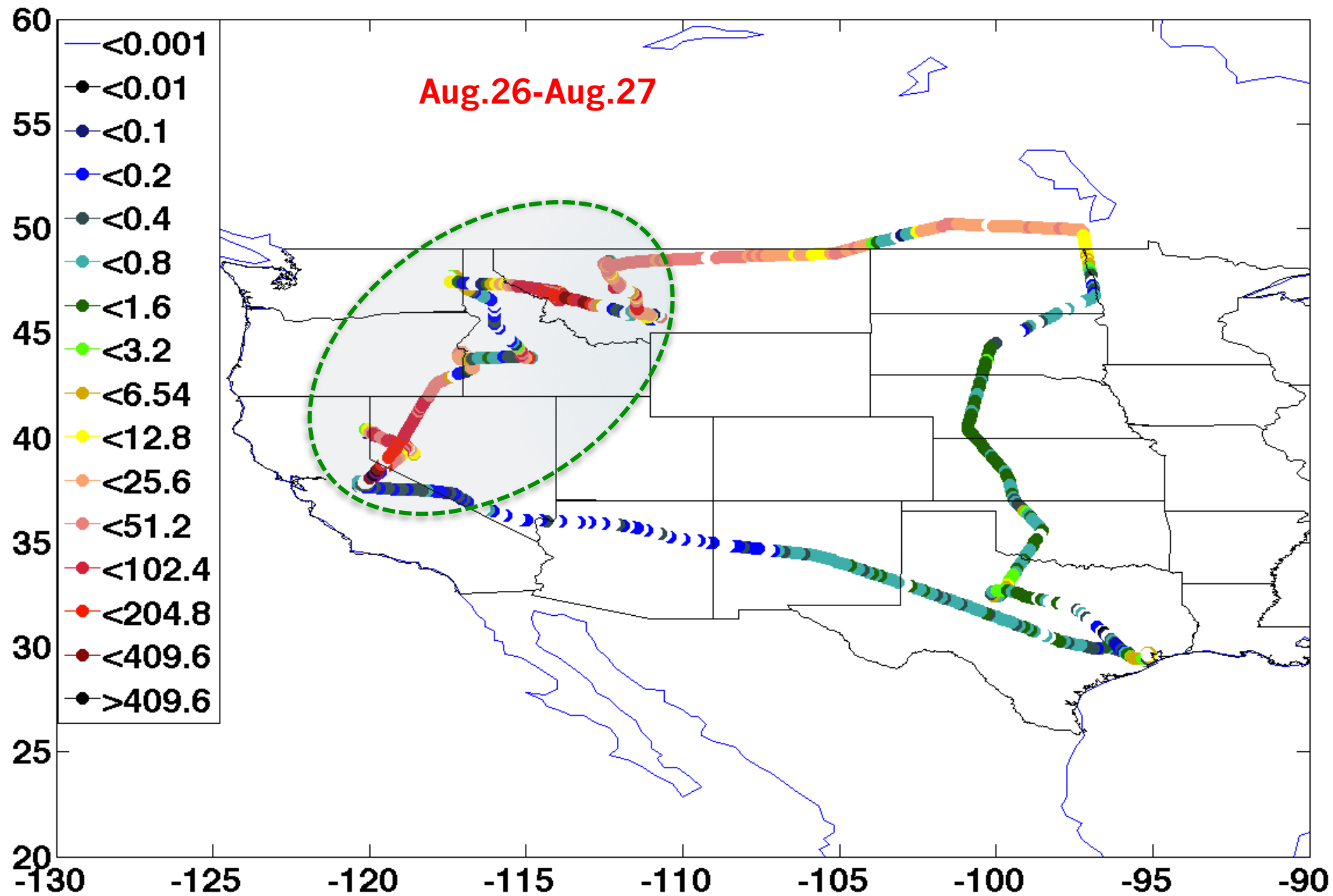
CARMA shows transport of Rim fire smoke



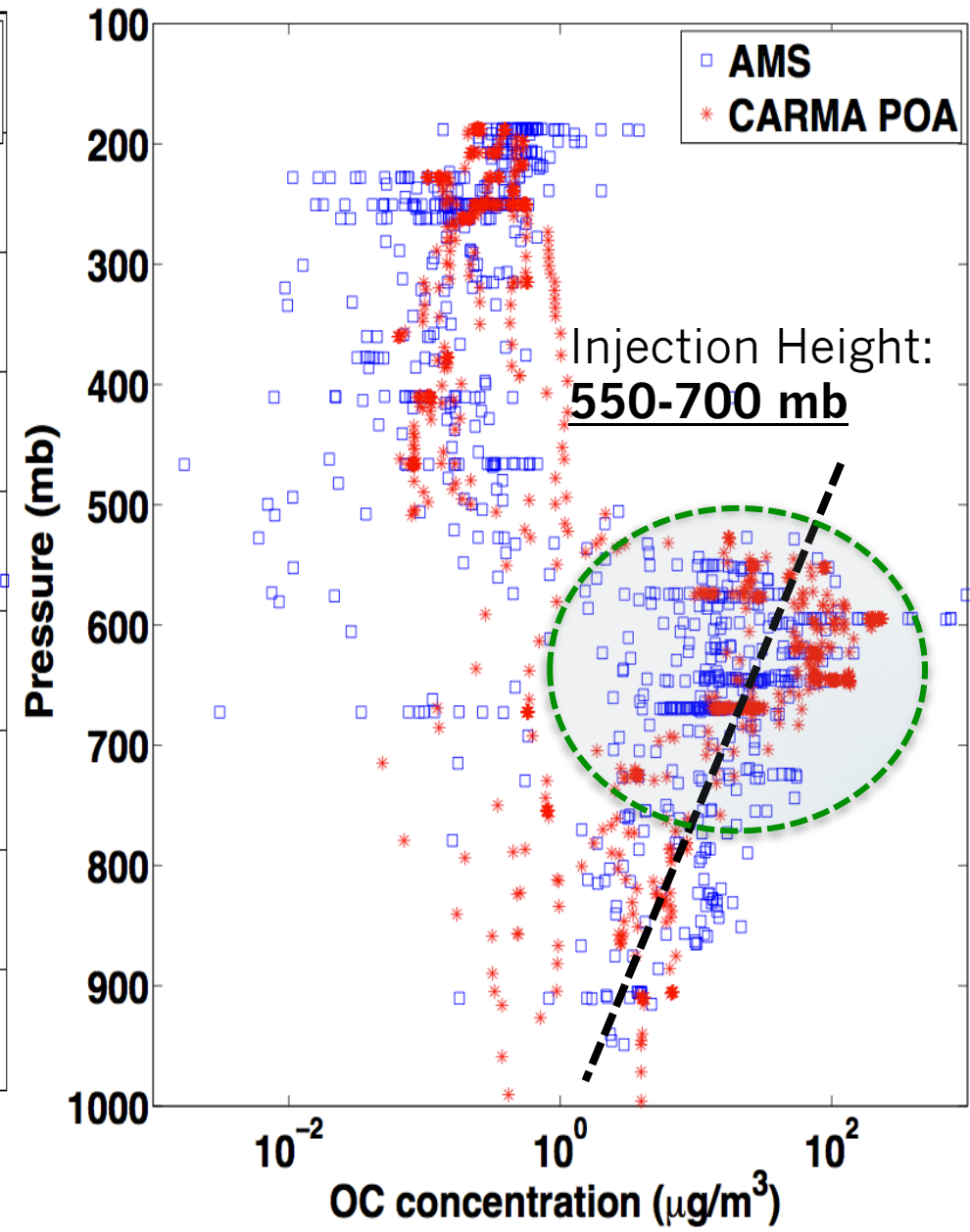
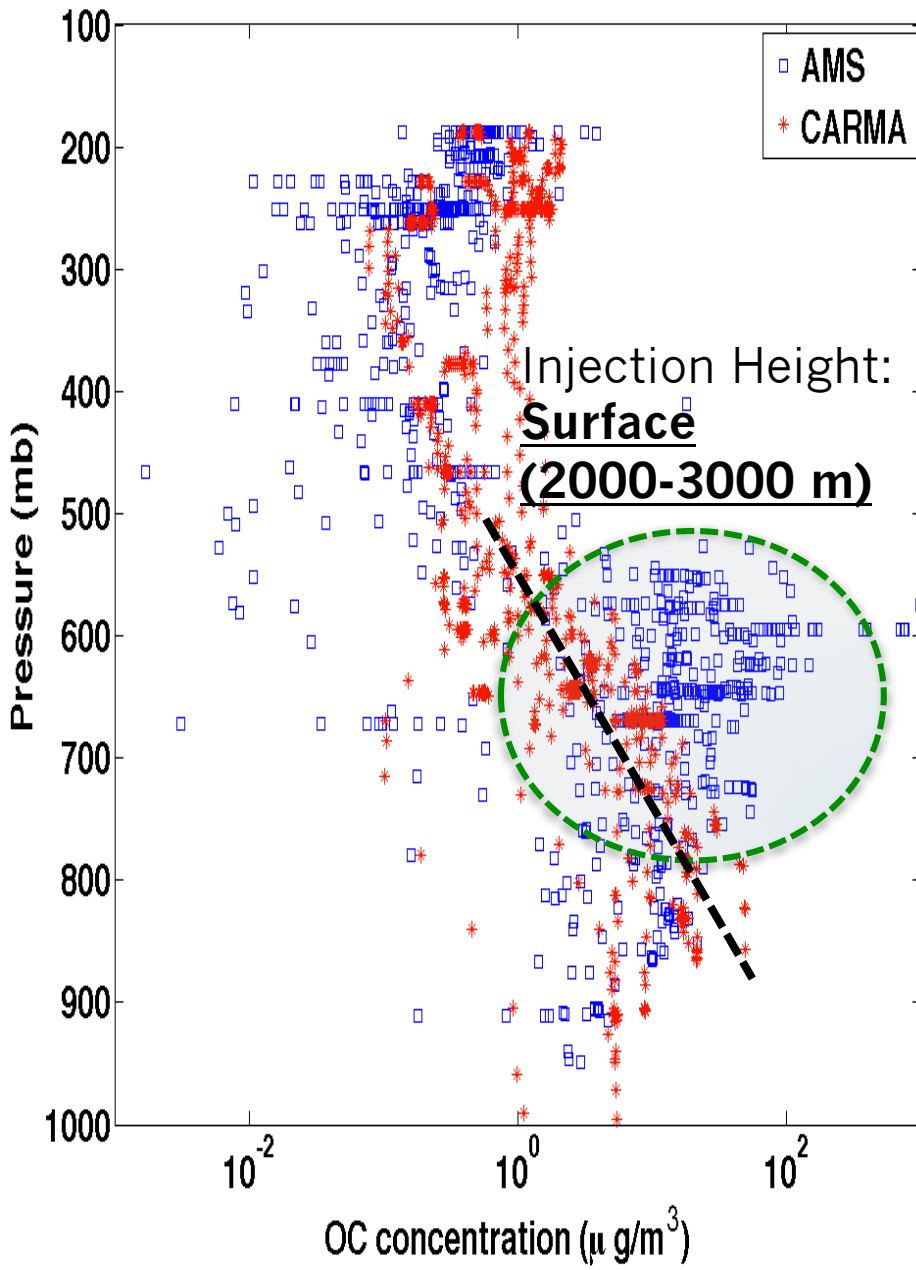
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2e-09 8e-09 6.4e-08 2.6e-07 1.04e-06 60W

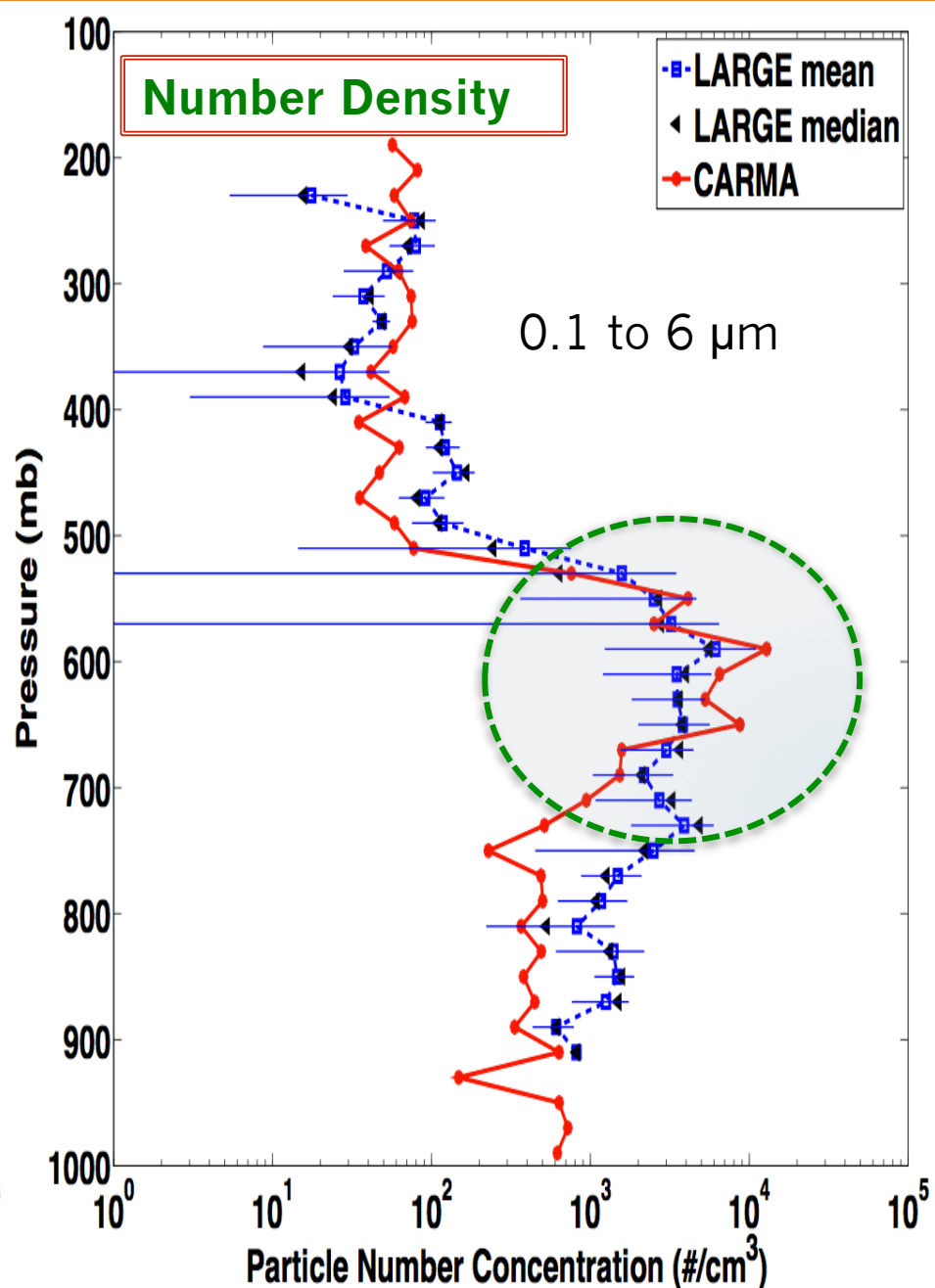
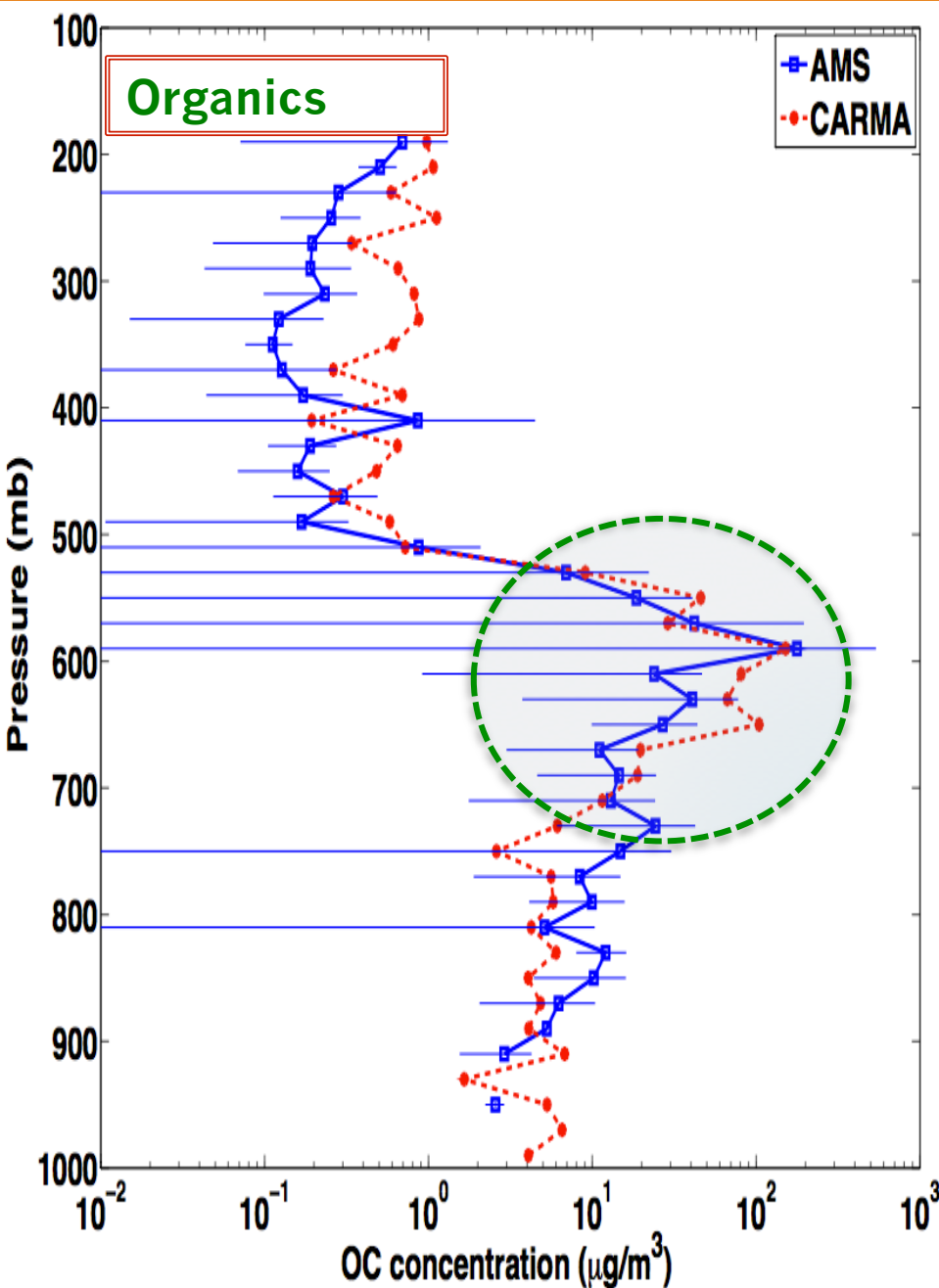
Focus on smoke regions with high OC concentrations



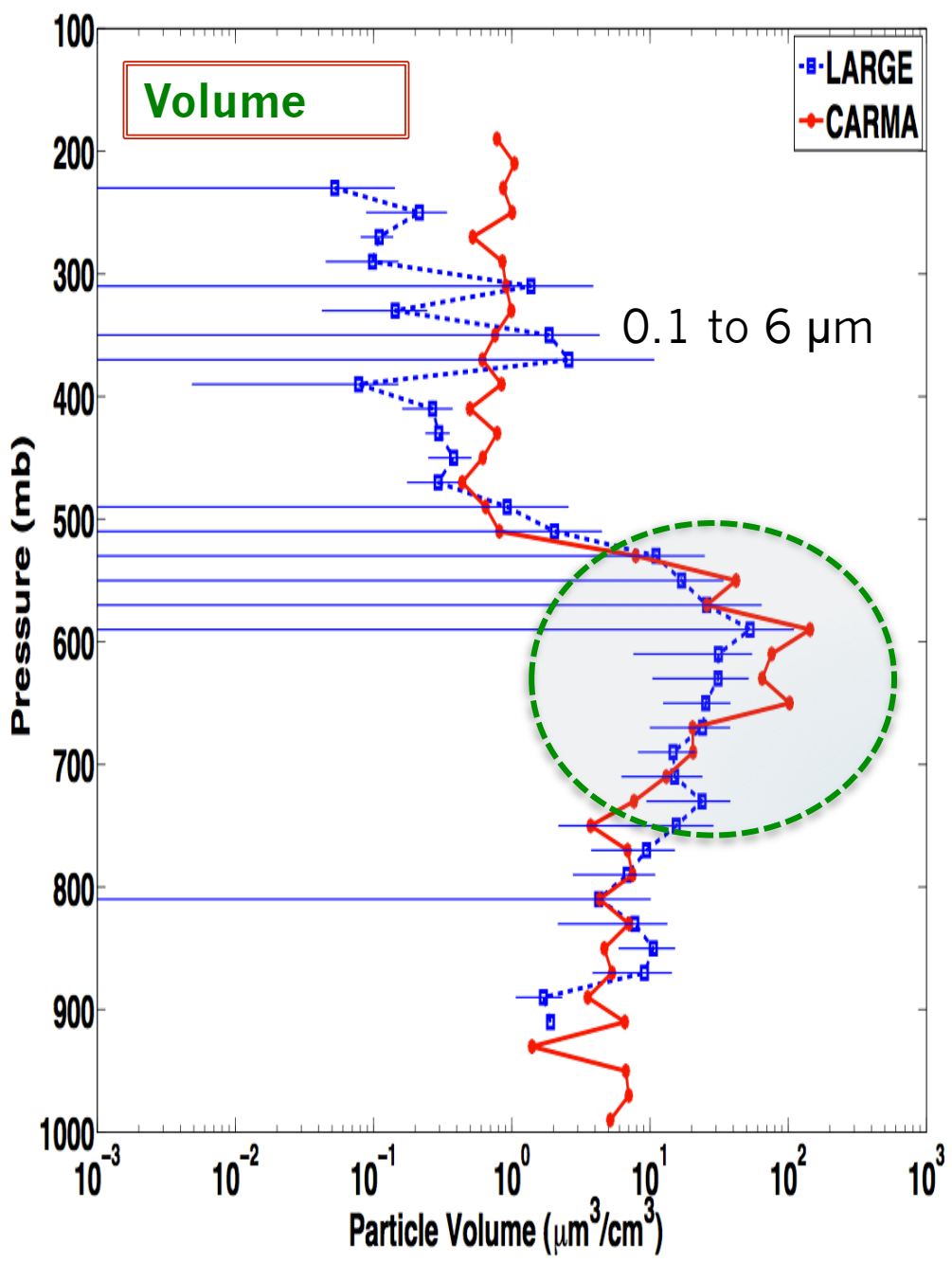
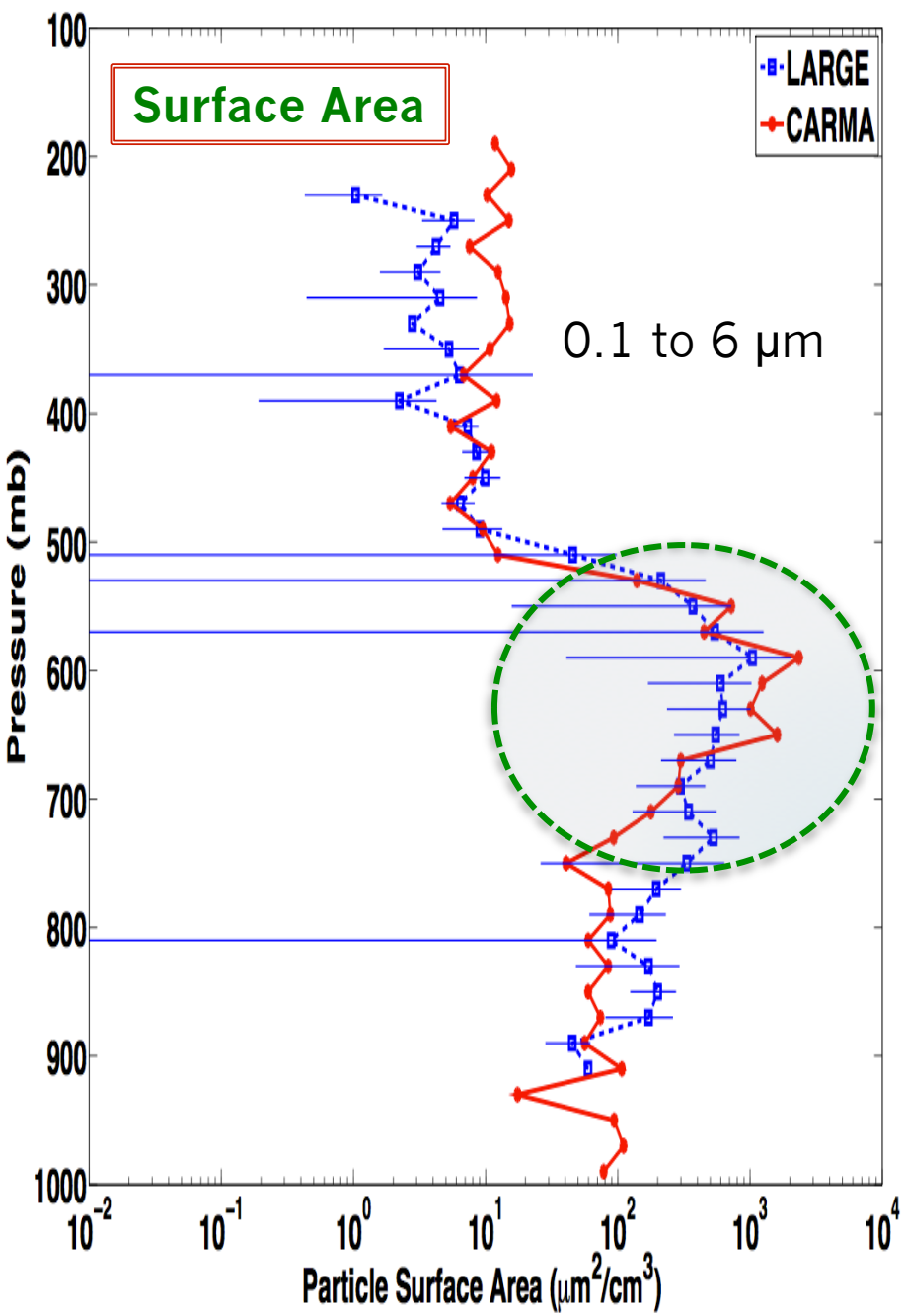
Putting fire emission into 550-700 mb gives better performance



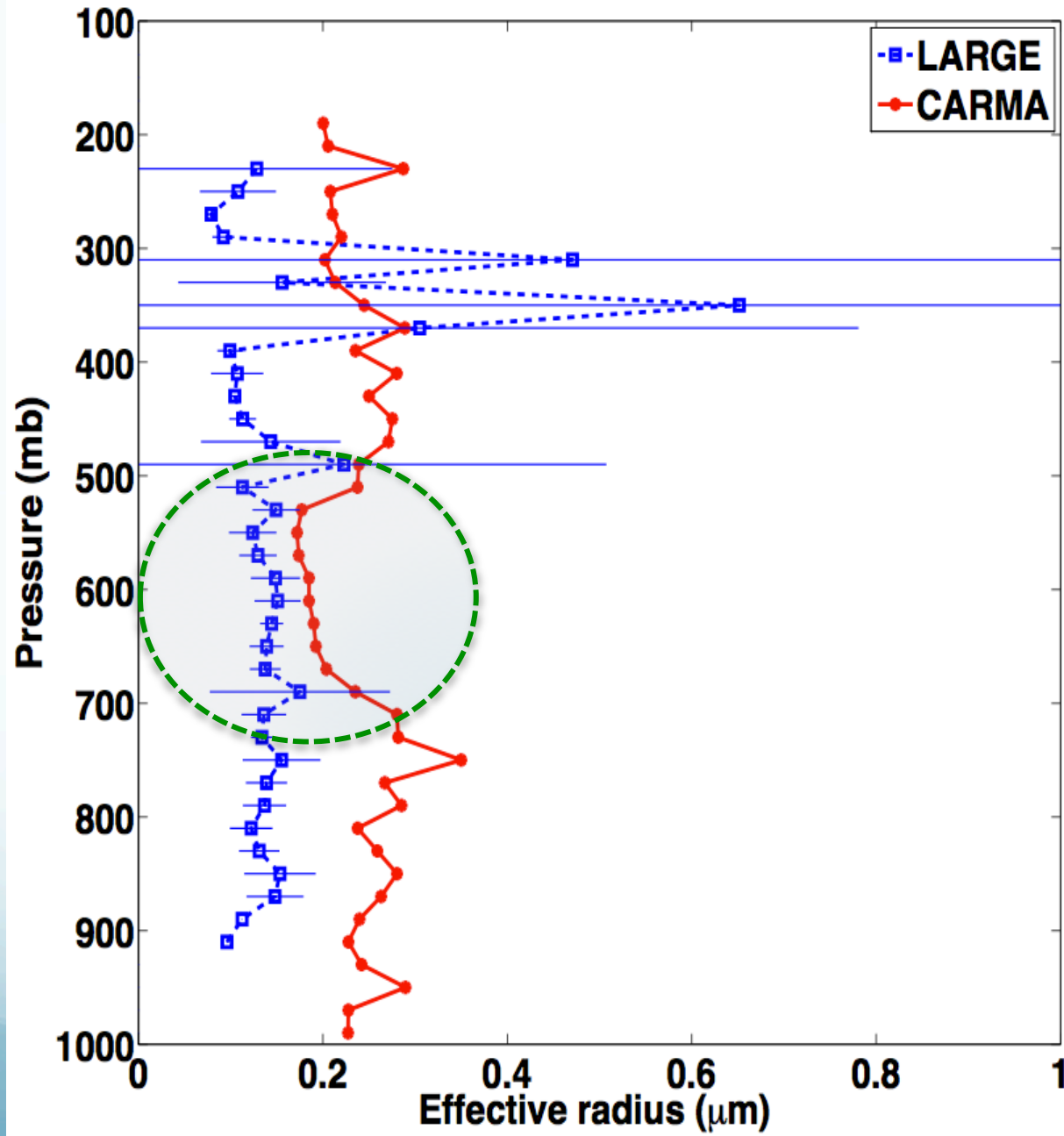
Model Captures Particle Mass/Number Concentration



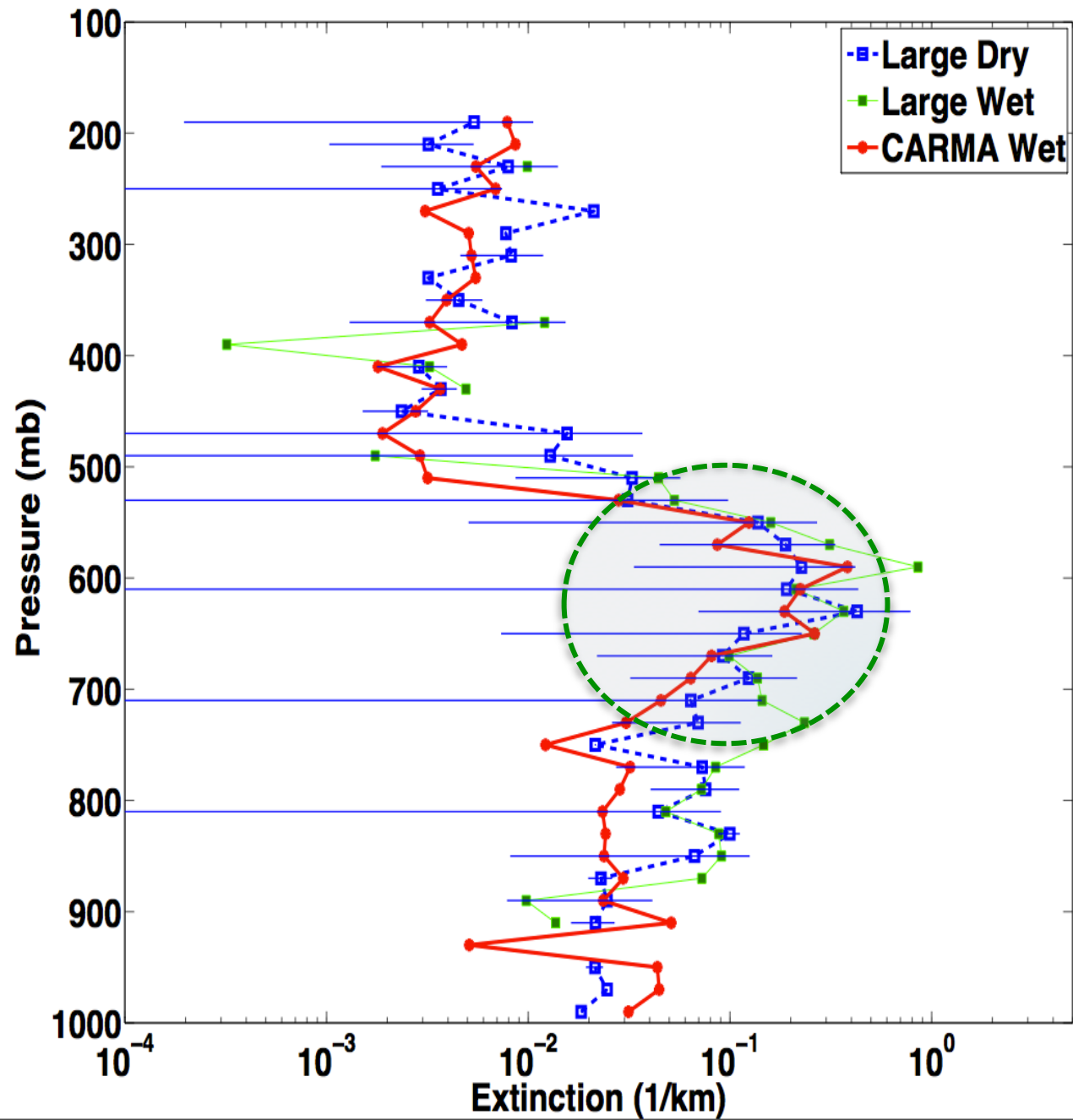
Model Captures Particle Surface Area and Volume Density



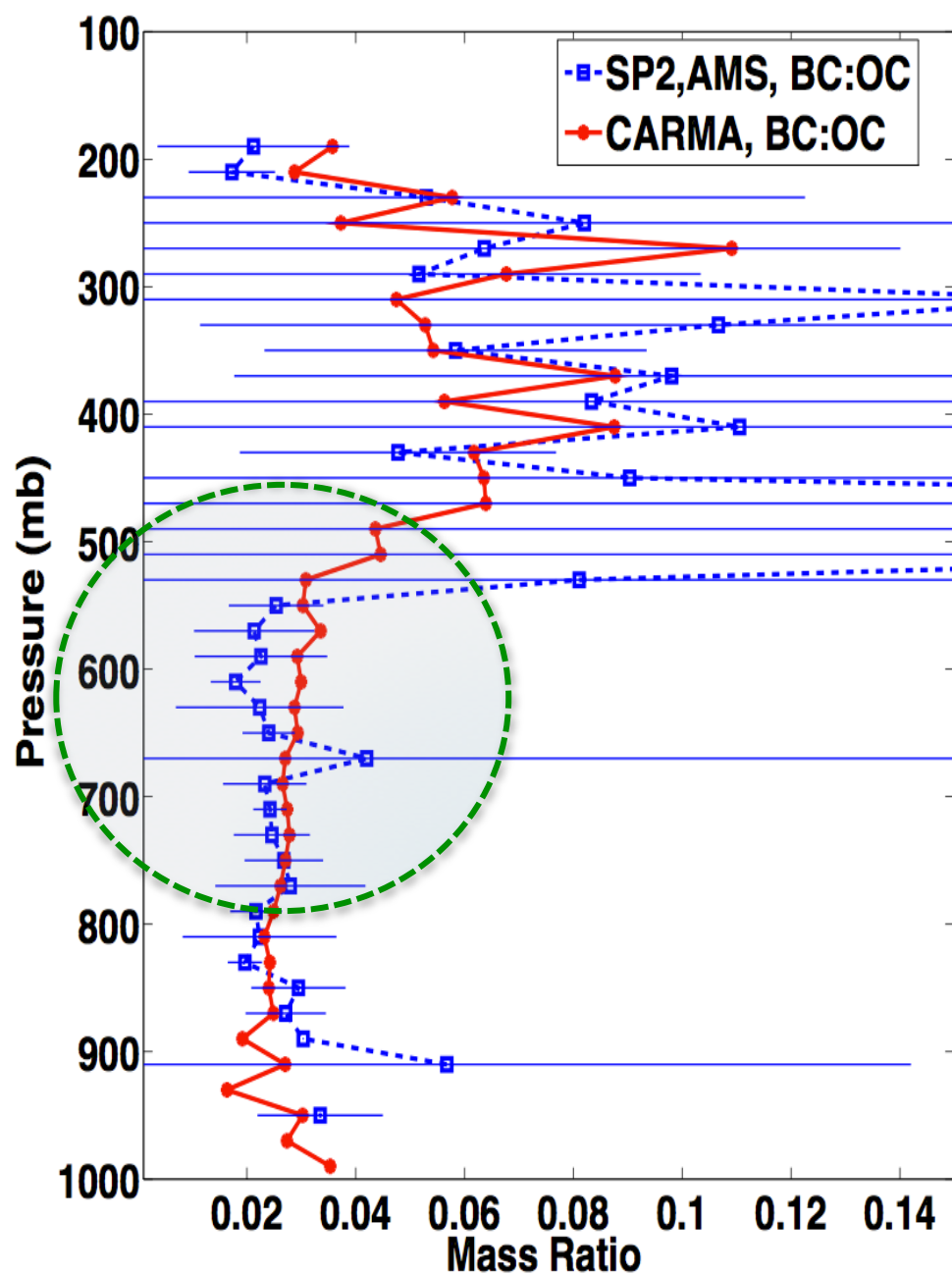
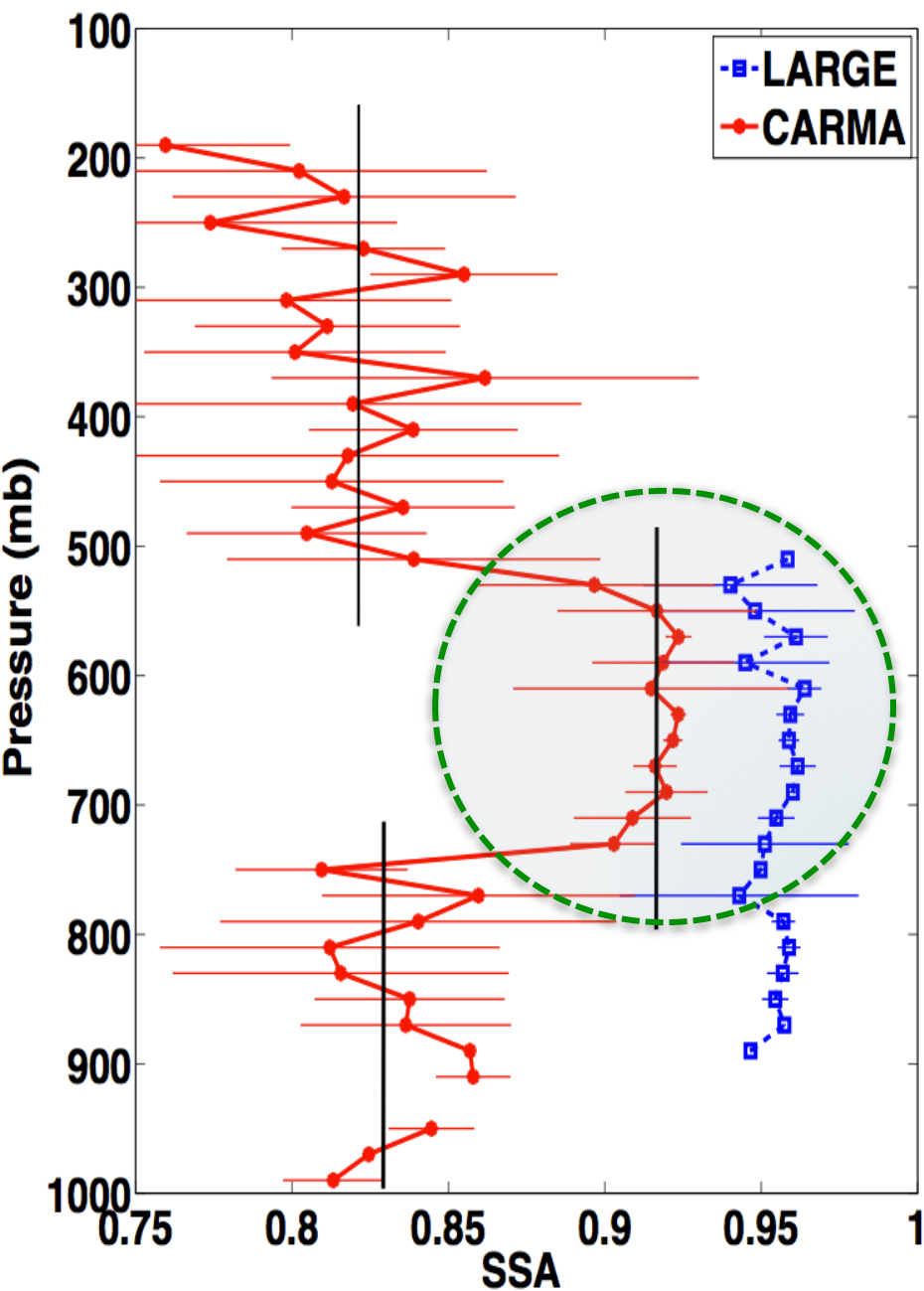
Effective radius of Rim Fire Smoke is 0.1-0.2 μm



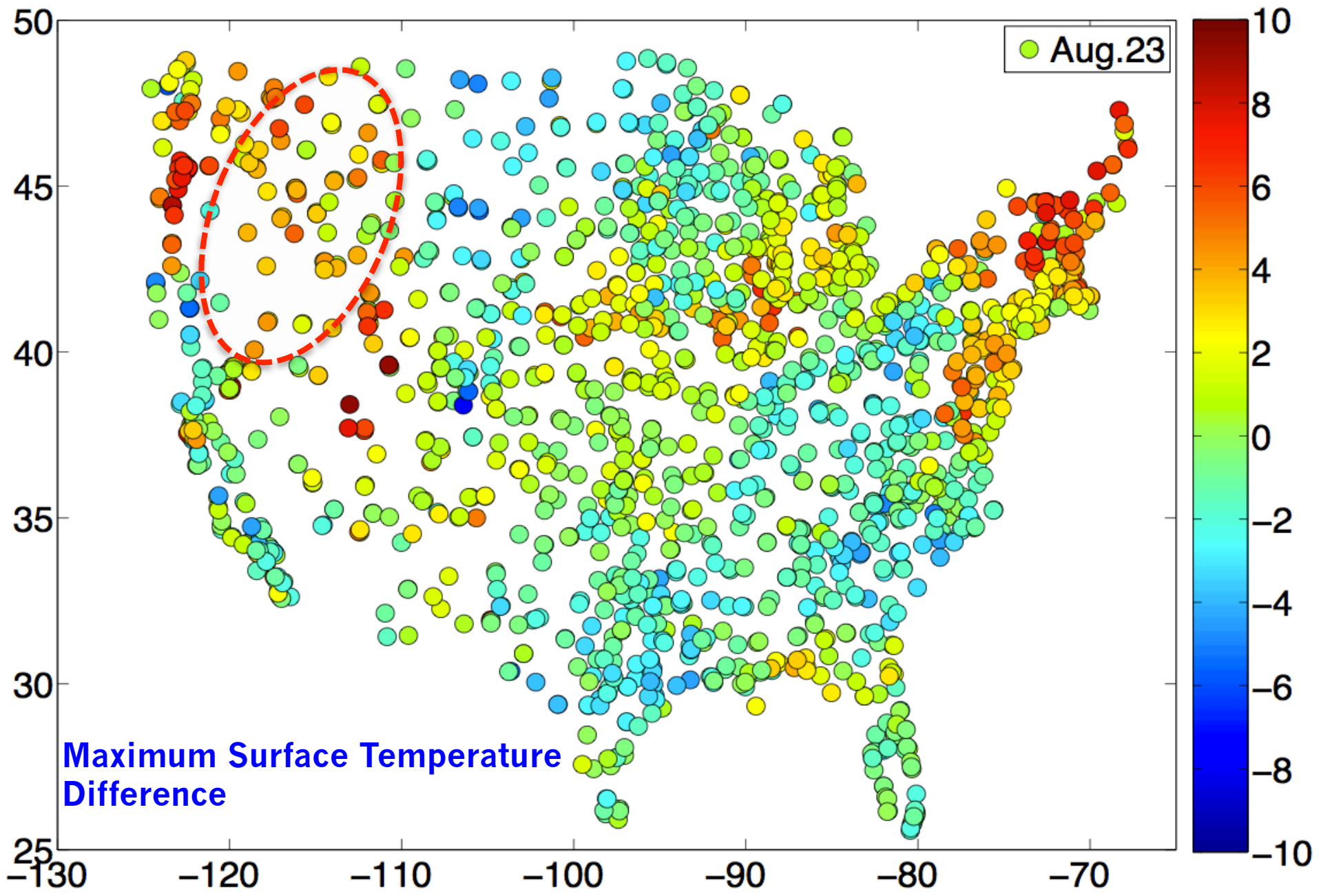
Model reproduce Aerosol Extinction within data variability

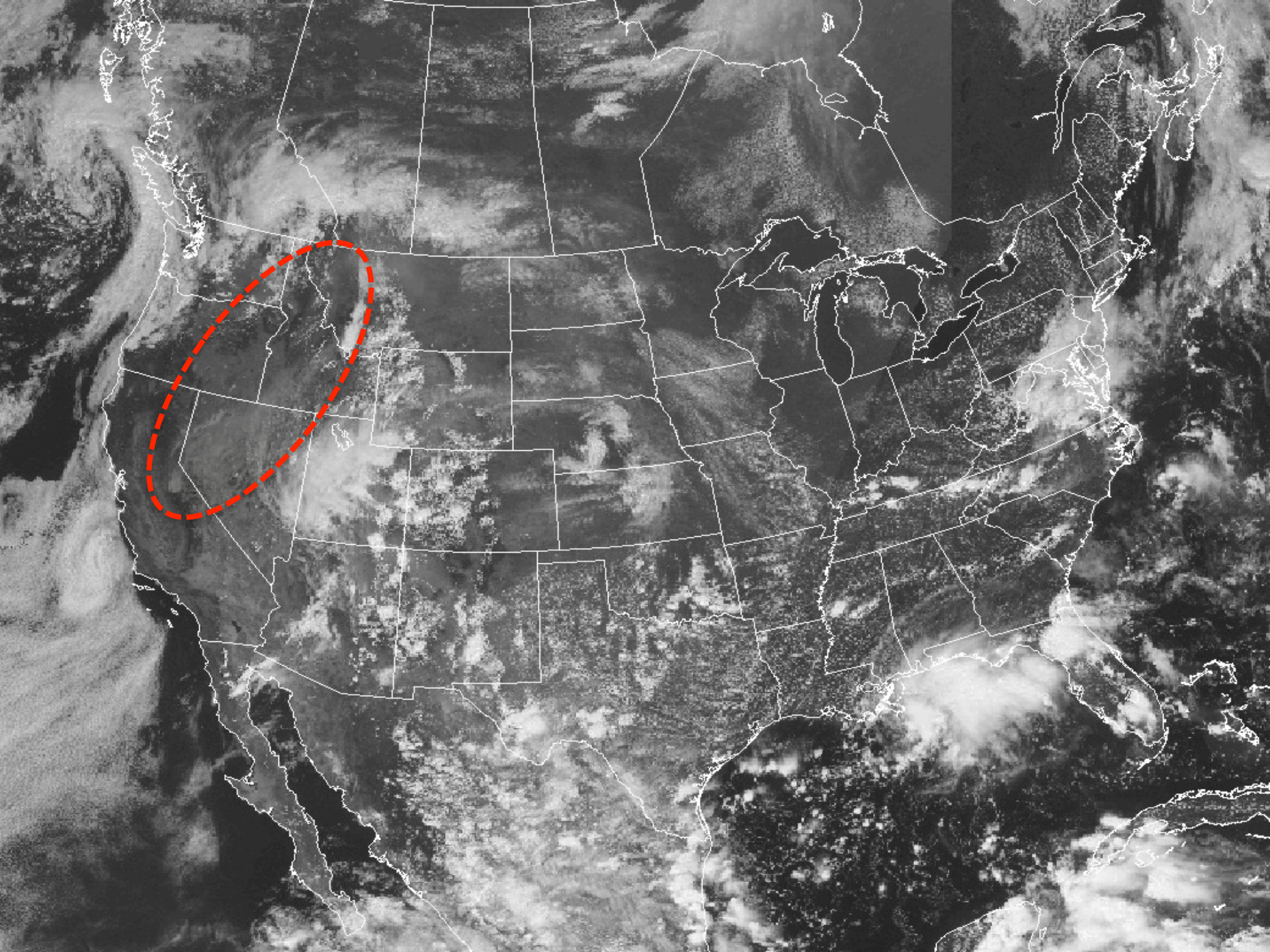


Modeled SSA is higher in Smoke, lower than Observations



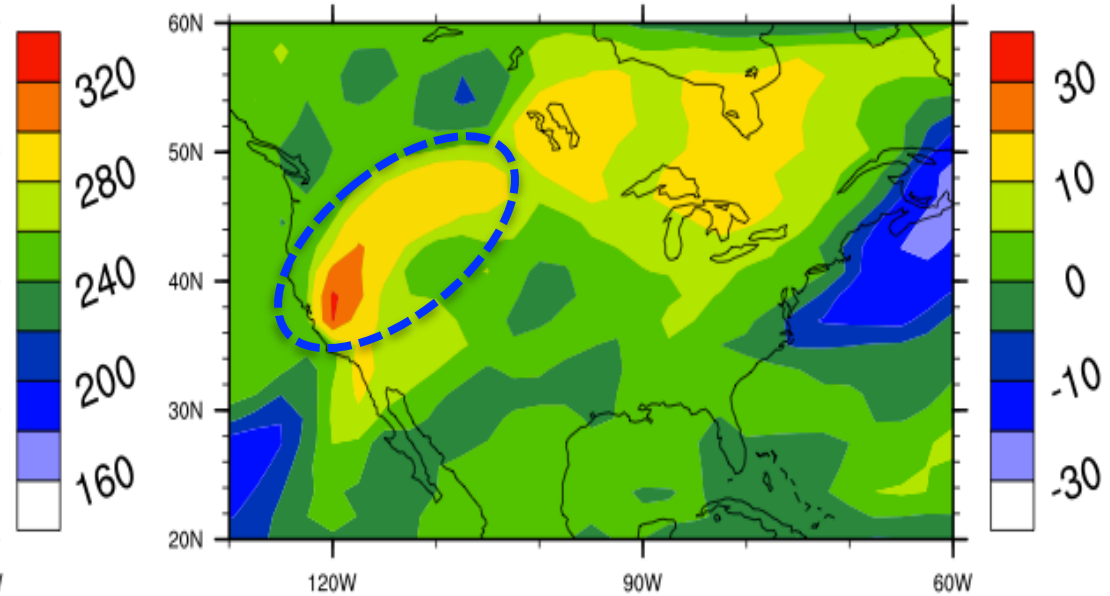
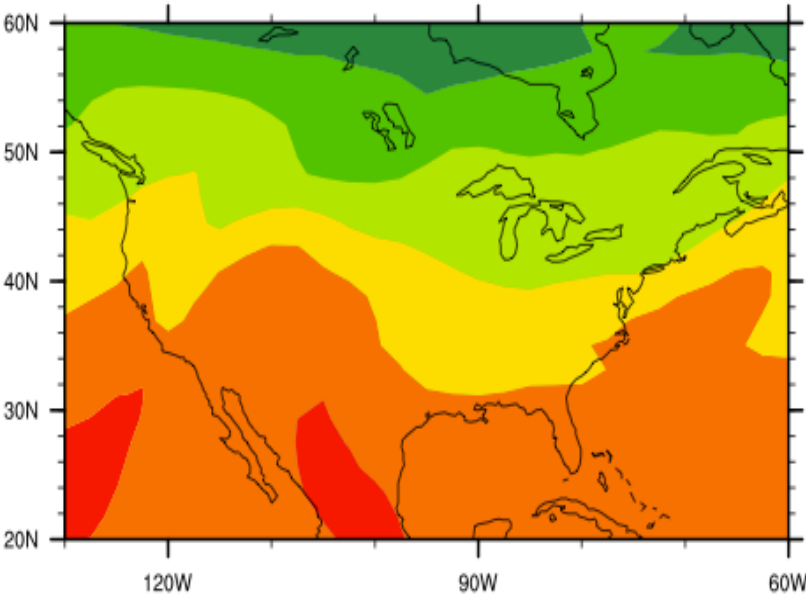
Cooling effect (2K-5K): Forecasting-Observations



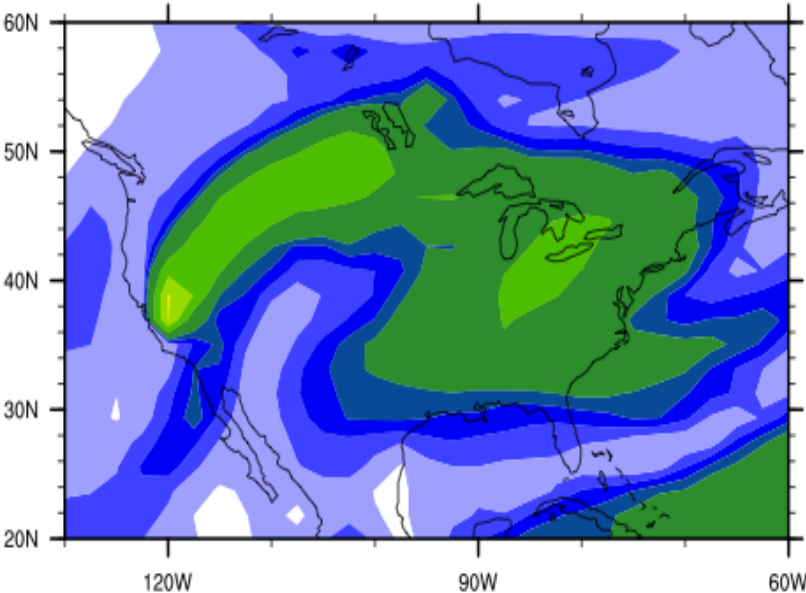


CARMA shows Rim Fire Blocks up to 10% of Sunlight

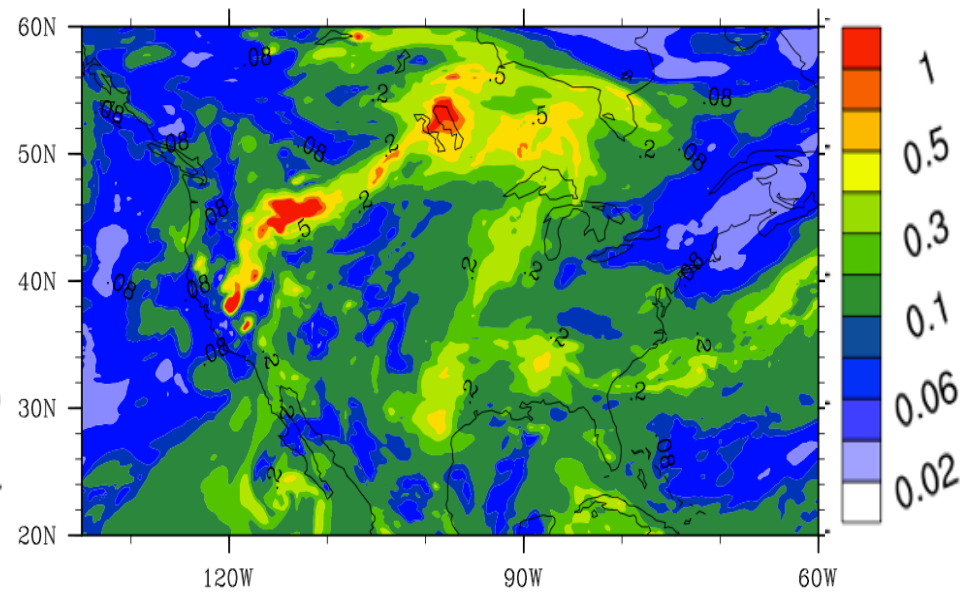
FSDS Rim [Clear sky downward surface forcing] FSDS diff



AOD Rim

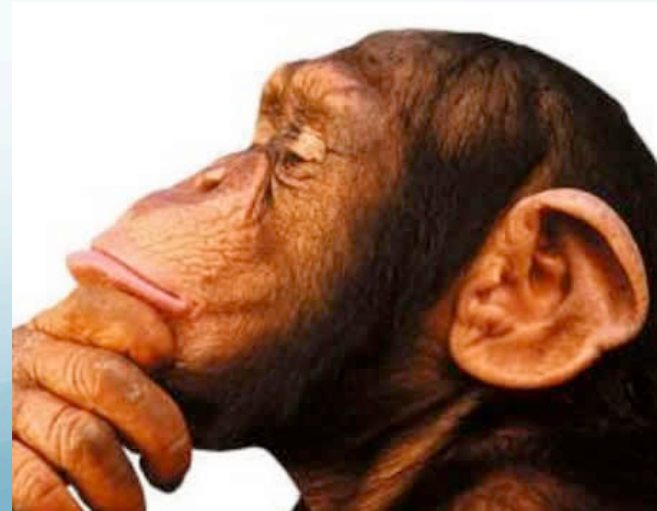


AOD Data Assimilation



Conclusions

- **CARMA can reproduce aerosol mass and number concentrations of rim fires within data's variability;**
- **Putting smoke emission in 550-700 mb gives better model performance.**
- **CARMA reproduces aerosol extinction coefficients;**
- **CARMA reproduces aerosol surface area and volume; the effective radius is 0.1-0.2 μm .**
- **Modeled SSA is lower than observation.**
- **Modeled SSA is higher in smoke.**
- **CARMA shows cooling effect of Rim Fire.**



THANKS

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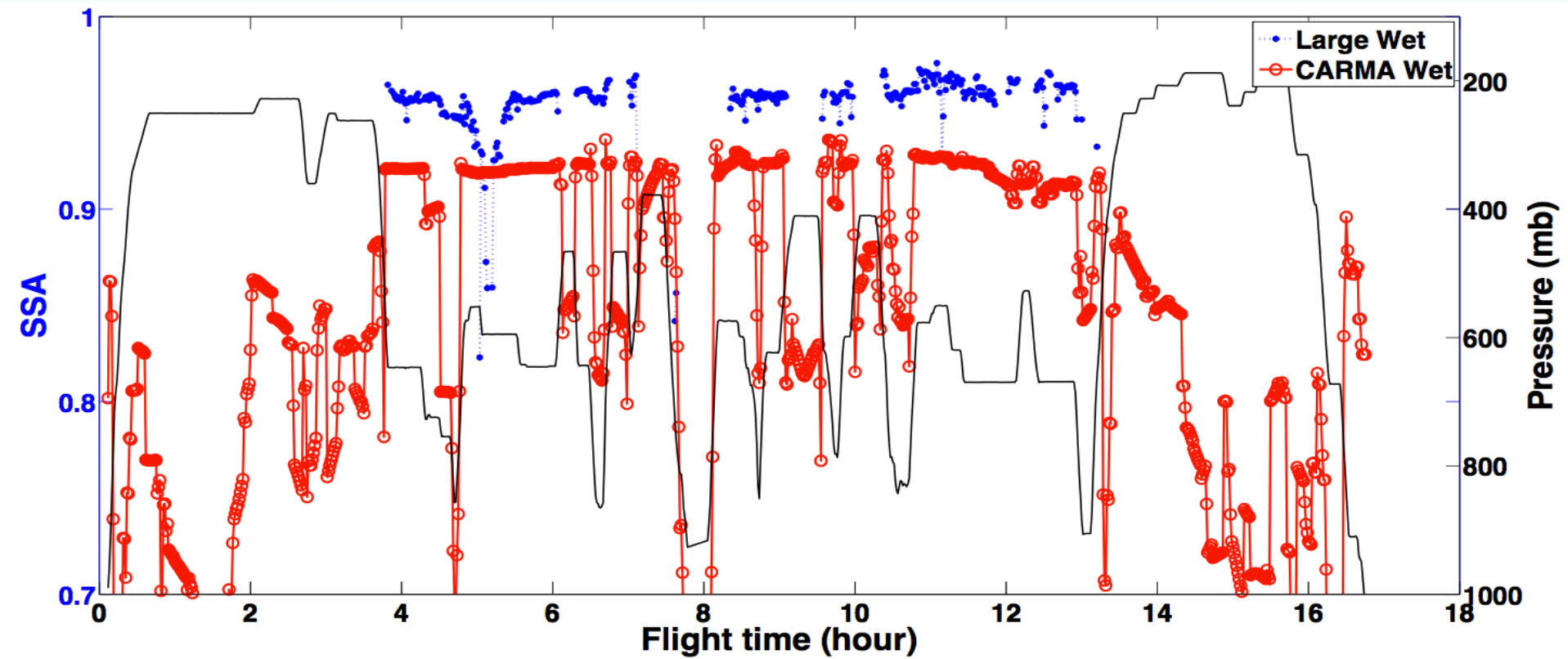
University of Colorado, Boulder



Thanks **Yellowstone (NSF&NCAR)**
GEOS-5 (NASA GSFC)

@ Houston, SEAC⁴RS, Sep.2013





CARMA shows SOA dominated in the upper troposphere

